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outright commendation, it, too, has been for science's sweet sake. *Non omnia possumus omnes.*

T. J. McCormack.

Elementare Stereometrie. Von *Dr. F. Bohnert*, in Hamburg. Mit 119 Figuren. Sammlung Schubert IV. Leipzig: G. J. Göschensche Verlagshandlung. 1902. Pages, iv, 183. Price, 2.40 Marks.

Mathematische Optik. Von *Dr. J. Classen*, Assistent am physikalischen Staatslaboratorium zu Hamburg. Mit 52 Figuren. Sammlung Schubert XL. Leipzig: G. J. Göschensche Verlagshandlung. 1901. Pages, x, 207. Price, 6 Marks.

Versicherungsmathematik. Von *Dr. Wilhelm Grossmann*. Sammlung Schubert XX. Leipzig: G. J. Göschensche Verlagshandlung. 1902. Pages, vi, 218. Price, 5 Marks.

Differential- und Integralrechnung. Erster Band: Differentialrechnung. Von *W. Franz Meyer*, in Königsberg in Pr. Mit 13 Figuren. Sammlung Schubert X. Göschensche Verlagshandlung. 1901. Pages, xviii, 395. Price, 10 Marks.

We have again to announce the appearance of several volumes of the admirable series of mathematical text-books edited by Professor Schubert of Hamburg, and are glad to see that the collection is so rapidly nearing completion. Designed to embrace all the departments of theoretical and applied mathematics (so far, forty volumes have been announced), its component works necessarily diverge widely from one another both in character and comprehensiveness, and despite the claim of the series for unity and systematic elaboration, the individual and technical idiosyncracies of the authors as well as the subjects of the different books, have to be taken into account in estimating their worth and usefulness.

To those acquainted with the excessive specialisation of mathematical thought in the last half century, the situation is quite intelligible. The natural direction has been departed from in the text-books of this field even more markedly than in the domain of physics, and while for those who have followed and assimilated it, it has brought both theoretical and practical power, to the uninitiated it is nothing less than bewildering, especially in its luxuriance of terminology and symbolism. If this symbolism and terminology were absolutely logical, as in many cases it is, and could be universally adopted, as in most cases it is not, there would be little objection to its exploitation. But its intricacies are sometimes arbitrary and altogether superfluous, and only add the hair-splitting subtleties of Mediævalism to the unnatural and inflexible logic of the Alexandrian school. Euclid still dominates to a large extent the presentation of mathematics. Mathematicians never tire of insisting that geometry is a "physical" science, yet how many text-books develop it from its physical basis, and present the sensuous images and resulting logical concepts of each department *genetically* and *phoronomically* from the start, before proceeding to establish the isolated and disjoined propositions that constitute in their logic "the necessary and sufficient" elements to construct a system? Most text-books of mathematics, like most text-books of physics and chemistry, where not the outcome of naïve dependence and imitation, appear to be written more to forestall the criticisms of colleagues, and to adhere unthinkingly to prevailing dogmas, than with the desire to open a new field of knowledge *permanently and with the least effort* to students. To sin in the statement of orthodox definitions, framed to conform with the most recent fashionable philosophy, or in the necessary orthodox baldness and unintelligible method of stating results and propositions, is much more to be deplored, it would seem, than lack of success in rendering the subject intelligible to learners. To meet the disapproval of men who have taken upon themselves the gratuitous task of defending the mathematical philosophy of a Gauss or a Riemann, or the physical philosophy of a Thomson and a Tait, is more to be feared than the damning to intellectual ruin of tens of thousands of innocent students whose posthumous protests will never be heard. But this is the rare privilege that educators, after the precedent of priests and princes, have reserved for themselves since that immemorial time when they thwacked with their blunted intellectual weapons the dunderpates of ancient Egypt. Add to this the endeavor of incoherently packing into an elementary text-book the sum-total of the results of all the various special methods of each department, and the cup of confusion is full.

It would be ungracious of us to apply any of the foregoing strictures in their full force to the books of Dr. Schubert's excellent series. They do vary in their plan and scope, greatly. Some of them are extremely simple and methodical, as for instance Dr. Schubert's *Arithmetic* and *Algebra*, Professor Pflüger's *Plane Geometry*, and Dr. Bohnert's *Trigonometry*, all formerly noticed in our pages. But it is a far cry from these books to Dr. Pund's *Algebra*, and the higher *Geometries* of Drs. Simon, Böger and Schröder,—not to mention Professor Holzmüller's very elaborate treatise on *Solid Geometry*. There does not, in fact, appear to be the same continuity between these works as there was between the little volumes of the small Göschen series, also edited by Dr. Schubert,—commendable as the larger volumes individually are. But this may be due to the fact that many of the constituent links of the series are still unpublished,—as, for instance, Dr. Schubert's *Elementary Analysis* (*Niedere Analysis*), from which, as from Professors Braunmühl and Günther's *History of Mathematics* we may expect much.

The four new works of the series which have just come to hand, are Dr. Bohnert's *Elements of Solid Geometry*, Dr. Classen's *Mathematical Optics*, Dr. Grossmann's *Mathematics of Insurance*, and Dr. Meyer's *Differential Calculus*.

Dr. Bohnert's book, like his *Trigonometry*, is kept within modest bounds; it treats of the conventional parts of solid geometry in tolerably genetic manner, and makes extended use, for example, of Cavalieri's principle, Guldin's and Simpson's rules, and also Heinze's principle. The conic sections are also briefly treated in their connection with solid figures. The author's chief indebtedness, which will characterise his work, is to Holzmüller, Servus, and Heinze.

Dr. Classen's work diverges considerably from the usual presentations of mathematical optics. He has sought to develop only those primary aspects of optics that are not in need of any special theoretical conception regarding the nature of light but may be deduced mathematically from a few indubitable experiential facts. Ordinarily, the undulatory theory, that is to say, phenomena of interference and diffraction, of polarisation and double refraction, are treated by preference, while the laws of geometrical optics are much neglected. The works on purely geometrical optics, on the other hand, sin in the opposite direction. Dr. Classen, now, after the precedent of W. Voigt, assumes five very simple facts, and then determines the form that must necessarily be assumed by the mathematical function that completely represents those facts, and reaches thus the general form of the undulatory function, which he developes for the special cases. He then proceeds to the phenomena of interference (Huygens's principle), and in a similar manner to the treatment of optic images (including Gauss's dioptrics, etc.), to the subject of achromatism, to Thiesen's theory, and to phenomena of diffraction. Polarisation and double refraction are excluded. Dr. Classen believes he has accomplished in this book what has never been accomplished before,—namely, presented in rigorous form all the facts that the student must be absolute master of before he can profitably take up investigations of the nature of light and of the more complicated luminous phenomena, or approach the construction and perfection of optical instruments. Some knowledge of the calculus is requisite to read the work.

Dr. Grossmann, in his book, has endeavored to present the mathematical formulæ controlling the application of the principles of insurance. He has developed these formulæ by elementary methods, and considered not only the forms of insurance connected with the life and death of one or several persons, but also the various modern forms of accident and invalid insurance. He has, in fine, furnished a book of value to the prospective actuary.

Dr. Meyer apologises for adding another treatise on the Calculus to the already large number of excellent text-books on this subject, but he has been moved to do so by the fact that the series would be incomplete without such a work. He has therefore written the book with special reference to this purpose and has actually considered the other books in so doing. Seeing that the applications of the Calculus to the physical sciences have been adequately treated by Nernst and Schoenfliess and by Lorenz, he has paid special attention to the subject of errors, with so much the more profit as these calculations are eminently characteristic of the Calculus, in its applications to the sciences. He has deferred the consideration of curves and surfaces, from the point of view of the Differential Calculus, to his second forthcoming volume on the Integral Calculus, to which he will also adjoin his historical notices.

Twenty-four volumes still remain to complete this comprehensive series, and it merely remains for us to add that the publishers of the series have done their utmost to secure the best possible typography compatible with cheapness, and that special point has been bestowed on obtaining accuracy and neatness in the figures. The impression is heavy, however, and does not do full justice to the typography.

T. J. McC.

THERMODYNAMIQUE ET CHIMIE. LEÇONS ÉLÉMENTAIRES A L'USAGE DES CHIMISTES. Par *P. Duhem.* Paris: Librairie Scientifique A. Hermann. 1902. Pages, ix, 496. Price, 15 francs.

Professor Duhem has added another work to his rapidly increasing list of excellent publications on physical chemistry, and prefaces the book, which will probably be more widely read than any that he has hitherto written, with the following remarks:

The development that thermodynamics has undergone in the last fifty years has attracted the attention of men who have devoted to it the most varied kinds of studies. Opinions not long since accepted without opposition regarding the aim and scope of physical theories, have been completely overthrown. Mechanics has ceased to be the ultimate explanation of the inorganic world; it is now nothing more than a chapter, though the simplest and most perfect, of a general body of knowledge that controls all the transformations of inanimate matter; and the question is not nòw that of discovering the inward nature and essence of these transformations, but solely to co-ordinate their laws by the help of a small number of fundamental postulates. And philosophy follows with anxious heart the phases of this evolution, which is one of the most considerable that cosmology has ever undergone.

At the beginning of the nineteenth century, mathematical physics furnished a multitude of fascinating and fecund problems to analysts; and the efforts which were put forth to resolve these problems have given rise to more than one branch of modern analysis; but the fear was rife that the veins worked by so many transcendent genuises had been exhausted. Now, the new doctrine generalises to the uttermost limits the data of the problems which were formerly attacked; it has given them an entirely new setting, and in this way has opened vast vistas to the researches of the mathematician.

The different branches of physics stand apparently isolated; each of them evokes its own principles, and proceeds by its own special methods. To-day, however, the physicist knows that his work is not concerned with a loosely-connected bundle of branches which are independent of one another, but with a tree of which the different boughs are the offshoots of the same trunk; all the parts of science that he cultivates appear to him rigorously connected, like the members of an organised body.

In a word, the laws formulated by thermodynamics introduce rational order into the most confused chapters of chemistry. A small number of simple and lucid